

**Cell 1 Regional Coastal Monitoring Programme
Update Report 6: 'Partial Measures' Survey 2014**

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Abbreviations and Acronyms

Acronym / Abbreviation	Definition
AONB	Area of Outstanding Natural Beauty
DGM	Digital Ground Model
HAT	Highest Astronomical Tide
LAT	Lowest Astronomical Tide
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWS	Mean Low Water Neap
MLWS	Mean Low Water Spring
m	metres
ODN	Ordnance Datum Newlyn

Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (m AOD)			
	River Tyne to Frenchman's Bay	Frenchman's Bay to Souter Point	Souter Point to Chourdon Point	Chourdon Point to Hartlepool Headland
1 in 200 year	3.41	3.44	3.66	3.91
HAT	2.85	2.88	3.18	3.30
MHWS	2.15	2.18	2.48	2.70
MLWS	-2.15	-2.12	-1.92	-1.90

Water Level Parameter	Water Level (m AOD)			
	Hartlepool Headland to Saltburn Scar	Skinningrove	Hummersea Scar to Sandsend Ness	Sandsend Ness to Saltwick Nab
1 in 200 year	3.87	3.86	4.1	3.88
HAT	3.25	3.18	3.15	3.10
MHWS	2.65	2.68	2.65	2.60
MLWS	-1.95	-2.13	-2.15	-2.20

Source: *River Tyne to Flamborough Head Shoreline Management Plan 2.*
Royal Haskoning, February 2007.

Glossary of Terms

Term	Definition
Beach nourishment	Artificial process of replenishing a beach with material from another source.
Berm crest	Ridge of sand or gravel deposited by wave action on the shore just above the normal high water mark.
Breaker zone	Area in the sea where the waves break.
Coastal squeeze	The reduction in habitat area which can arise if the natural landward migration of a habitat under sea level rise is prevented by the fixing of the high water mark, e.g. a sea wall.
Downdrift	Direction of alongshore movement of beach materials.
Ebb-tide	The falling tide, part of the tidal cycle between high water and the next low water.
Fetch	Length of water over which a given wind has blown that determines the size of the waves produced.
Flood-tide	Rising tide, part of the tidal cycle between low water and the next high water.
Foreshore	Zone between the high water and low water marks, also known as the intertidal zone.
Geomorphology	The branch of physical geography/geology which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc.
Groyne	Shore protection structure built perpendicular to the shore; designed to trap sediment.
Mean High Water (MHW)	The average of all high waters observed over a sufficiently long period.
Mean Low Water (MLW)	The average of all low waters observed over a sufficiently long period.
Mean Sea Level (MSL)	Average height of the sea surface over a 19-year period.
Offshore zone	Extends from the low water mark to a water depth of about 15 m and is permanently covered with water.
Storm surge	A rise in the sea surface on an open coast, resulting from a storm.
Swell	Waves that have travelled out of the area in which they were generated.
Tidal prism	The volume of water within the estuary between the level of high and low tide, typically taken for mean spring tides.
Tide	Periodic rising and falling of large bodies of water resulting from the gravitational attraction of the moon and sun acting on the rotating earth.
Topography	Configuration of a surface including its relief and the position of its natural and man-made features.
Transgression	The landward movement of the shoreline in response to a rise in relative sea level.
Updrift	Direction opposite to the predominant movement of longshore transport.
Wave direction	Direction from which a wave approaches.
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water.

Preamble

The Cell 1 Regional Coastal Monitoring Programme covers approximately 300km of the north east coastline, from the Scottish Border (just south of St. Abb's Head) to Flamborough Head in East Yorkshire. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 1).

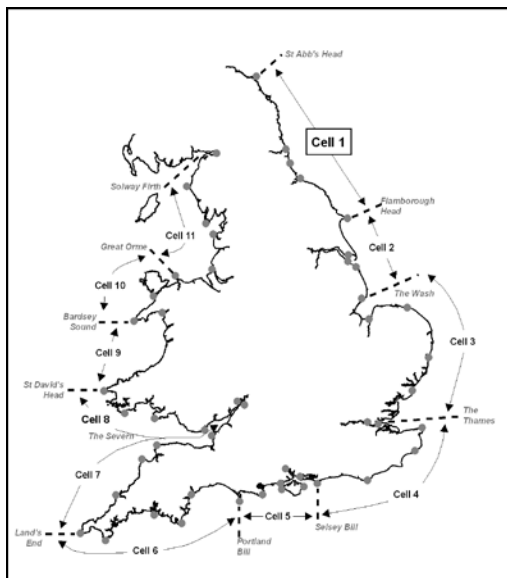


Figure 1 Sediment Cells in England and Wales

The main elements of the Cell 1 Regional Coastal Monitoring Programme involve:

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- walk-over surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn/early winter every year. Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey. To date the following reports have been produced:

Table 1 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sep-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	July 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-April 11	August 11	Sept 11
4	2011/12	Sep-Oct 11	Oct 12	Mar-May 12	Oct 12	-
5	2012/13	Sep 12	Jan 13	April 13	May 13	-
6	2013/14	Sep-Oct 14	Feb 14	March 13	July 14(*)	

(*) The present report is **Update Report 6** and provides an analysis of the 2014 Partial Measures survey for Hartlepool Council's frontage.

1. Introduction

1.1 Study Area

Hartlepool Council's frontage extends from Crimdon Beck in the north to the North Gare Breakwater in the south. For the purposes of this report, it has been sub-divided into four areas, namely:

- North Sands
- Hartlepool Headland
- Middleton
- Hartlepool Bay

1.2 Methodology

Along Hartlepool Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along twelve transect lines
 - Topographic survey along part of North Sands (referred to as Hartlepool North)
 - Topographic survey along Middleton (referred to as Hartlepool Central)
 - Topographic survey along Hartlepool Bay (referred to as Hartlepool South)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along twelve transect lines
- Additionally, every five years (starting with 2008 as the baseline year), the Full Measures survey at Hartlepool North is extended to fully cover the whole of North Sands and Hartlepool Headland with a topographic survey. This extends across the boundary of jurisdiction between Hartlepool Borough Council and Durham County Council.

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 18th March and 19th March 2014. During this time weather conditions were cloudy with sunny spells (Hartlepool Central and South) and cloudy with showers (Hartlepool North), with a force 4 wind from the east and a calm sea state at all sites.

On 5th December 2013 a significant storm surge, driven by strong northerly winds, coincided with one of the highest astronomical tides of the year. A comparison of the recorded water level data for the December 2013 storm surge at North Shields, Whitby and Scarborough has been provided in the second wave Data analysis report covering the period 2013 to 2014. Recorded surge residuals from that report show a similar signature at the three sites, with the maximum surge height occurring before high water and the surge increasing in height as it progressed down the coast, from around 1.3m above predicted water level at North Shields to around 1.8m at Whitby and Scarborough. Based on the EA (2011) Coastal Flood Boundary Condition extreme water level data the surge had the following chance of occurrence each year:

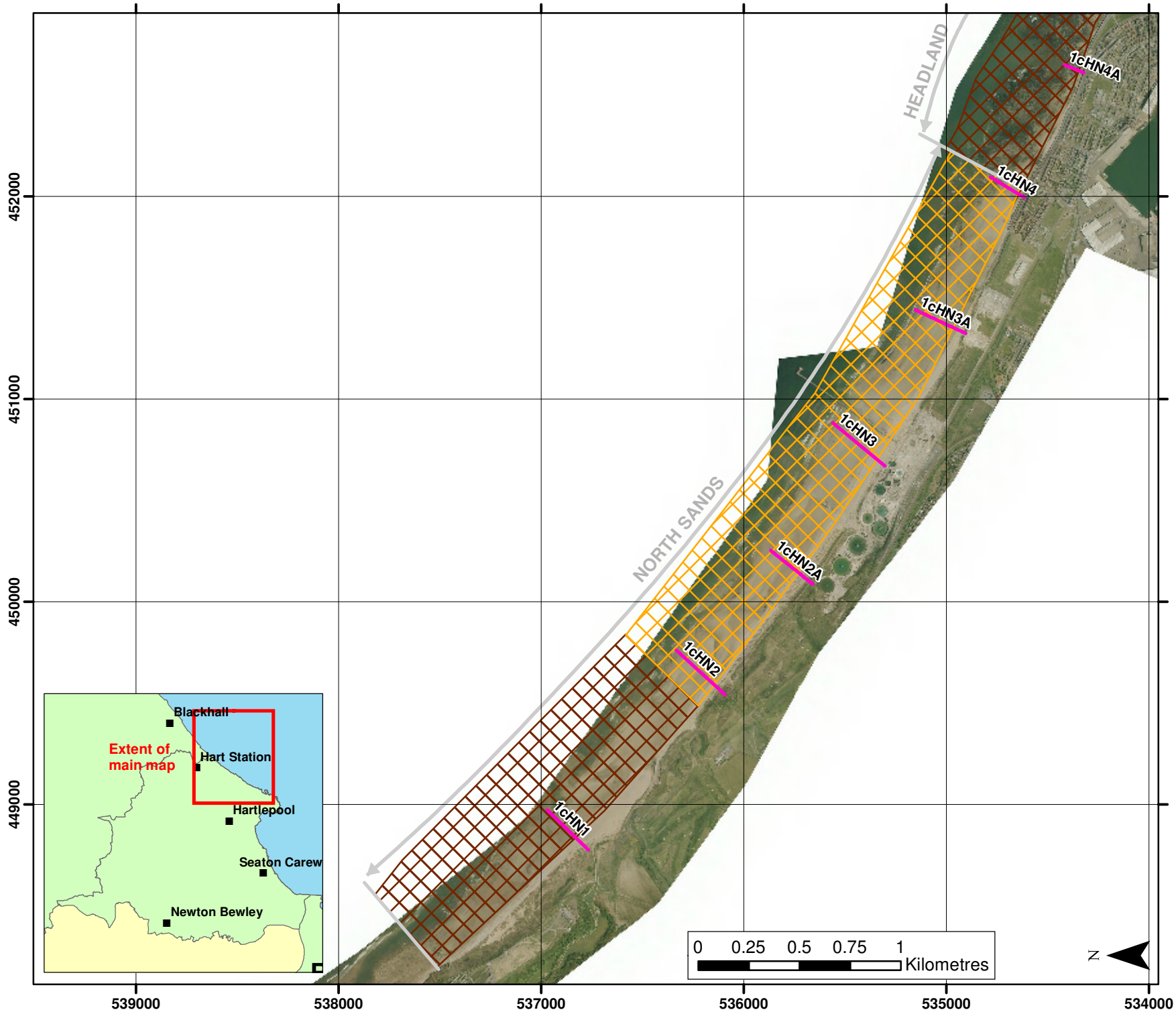
- North Shields: between 1 in 200 and 1 in 500
- Whitby: between 1 in 100 and 1 in 500
- Scarborough: between 1 in 150 and 1 in 500

The Update Report presents the following:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes. Particular attention is paid to determining any residual impacts of the storm surge that occurred in December 2013 (Section 2);

- documentation of any problems encountered during surveying or uncertainties inherent in the analysis (Section 3);
- recommendations for 'fine-tuning' the programme to enhance its outputs (Section 4); and
- provision of key conclusions and highlighting any areas of concern (Section 5).

Data from the present survey are presented in a processed form in the Appendices.



KEY

Topographic Profiles

- Annual (Blue line)
- 6 monthly (Pink line)

Topographic Surveys

- 6 monthly (Green grid)
- yearly (Yellow grid)
- 5 yearly (Brown grid)

Cliff Top Monitoring Pegs

- 50m centres (Purple bar)
- 100m centres (Light Green bar)
- 300m centres (Red bar)

(Indicative survey extents shown)

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 1
Survey Locations
North Sands
Hartlepool Borough Council

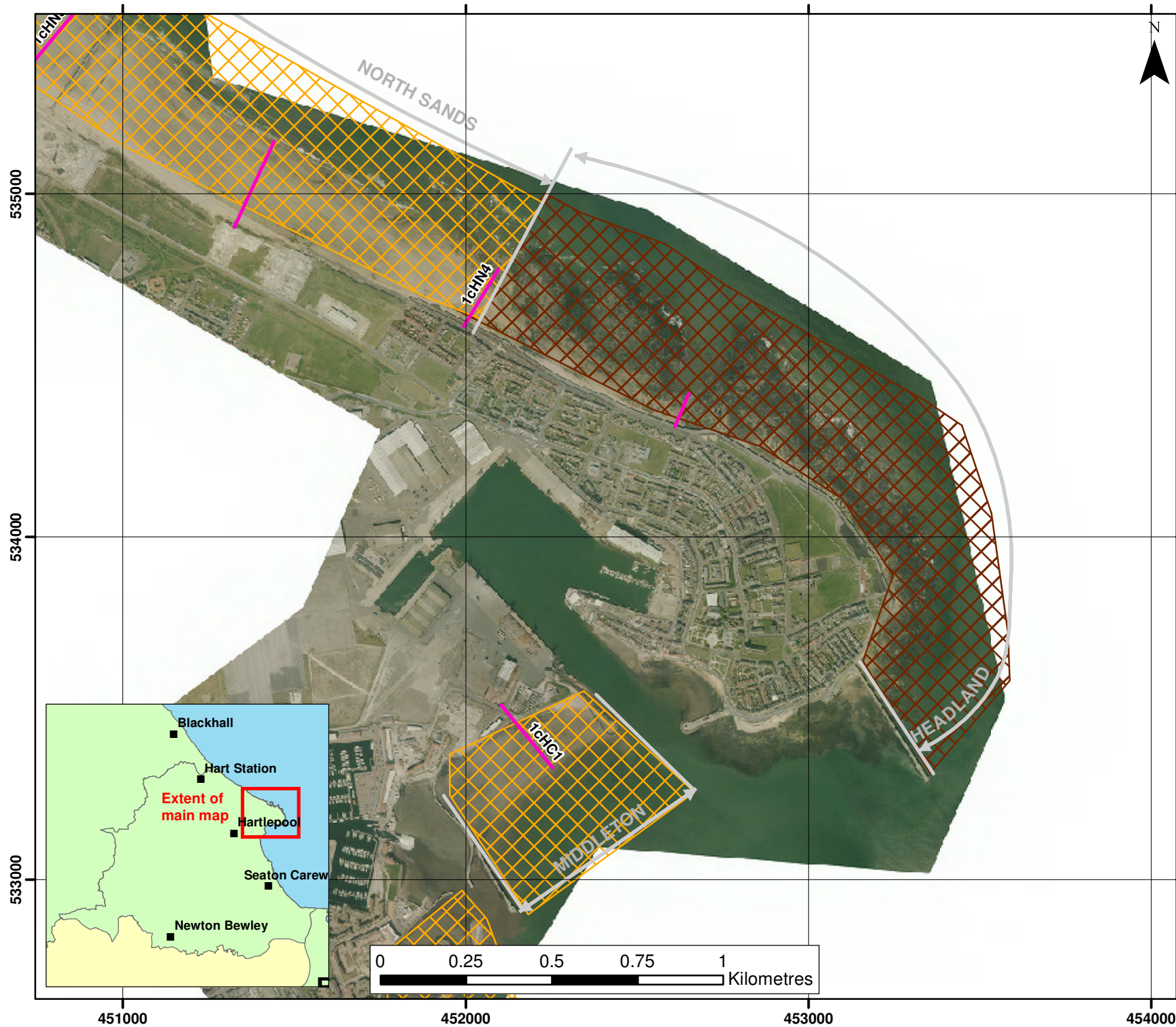
Update Report 6
 Partial Measures Survey
 Spring 2014

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 www.northeastcoastalobservatory.org.uk



KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- 50m centres
- 100m centres
- 300m centres

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2 - Map 2
Survey Locations
Headland and Middleton
Hartlepool Borough
Council**

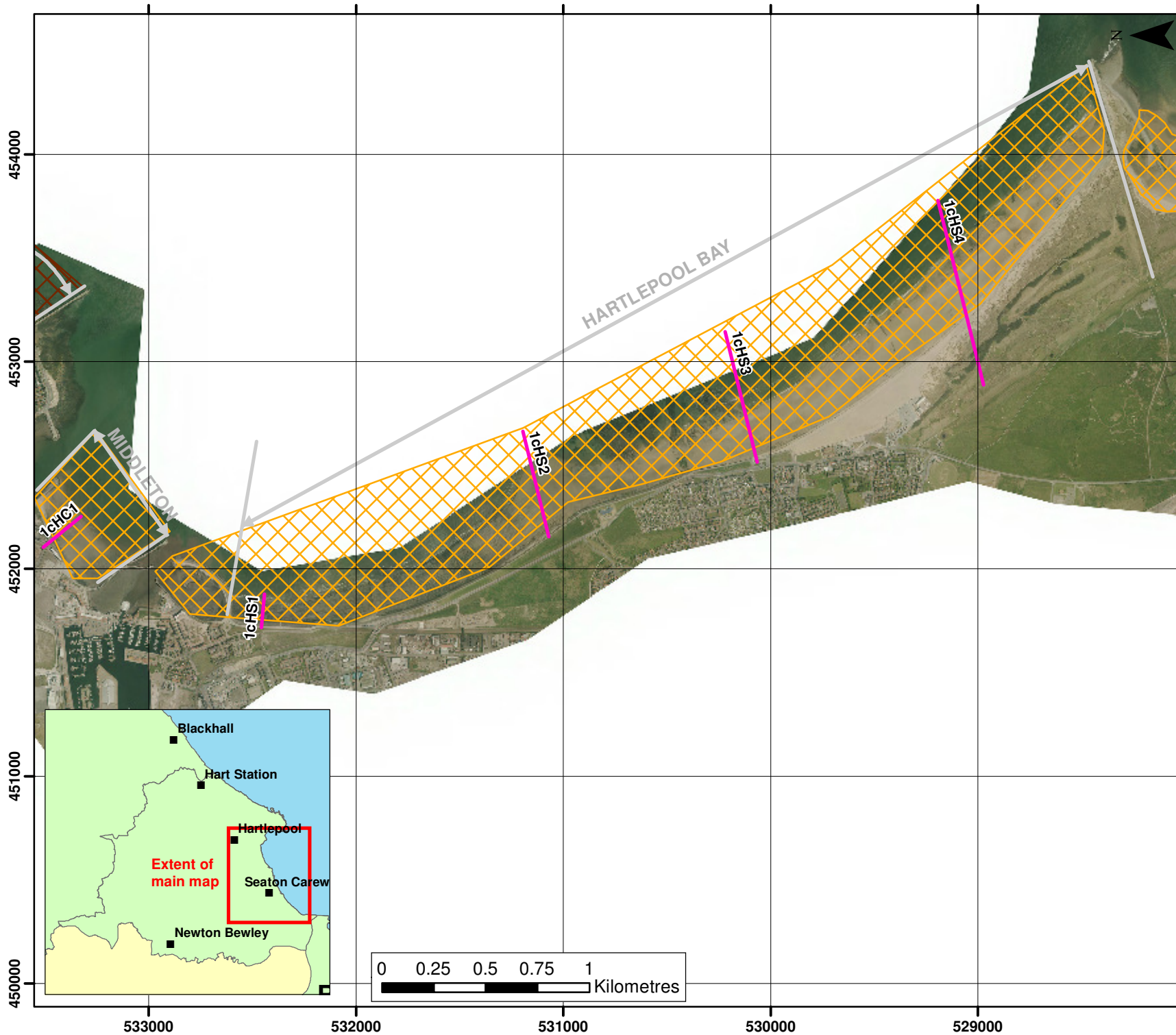
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KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- ▨ 6 monthly
- ▨ yearly
- ▨ 5 yearly

Cliff Top Monitoring Pegs

- 50m centres
- 100m centres
- 300m centres

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2- Map 3
Survey Locations
Hartlepool Bay
Hartlepool Borough
Council**

UpdateReport 6
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Spring 2014

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2. Analysis of Survey Data

2.1 North Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>18th March 2014</p>	<p>Beach Profiles:</p> <p>North Sands is covered by four beach profile lines during the Partial Measures survey (Appendix A) that were last surveyed in September 2012.</p> <p>Profile 1cHN1 is located within Durham County Council's jurisdiction, about 400m north of the outfall of Crimdon Beck, but has been reported here so changes can be interpreted in association with those observed elsewhere along North Sands at 1cHN2, 1cHN3 and 1cHN4. The March 2014 profile for 1cHN1 is very similar to the October 2014 survey until 51m chainage. Between 51m and 71m chainage the level of the profile has dropped by around 0.7m. From 71m to 100m chainage the beach has accreted since the last survey. Between 100m and 155m chainage the beach level is up to 0.4m lower than the previous survey and between 155m and 195m chainage the beach has accreted by around 0.4m. At the base of the profile from 195m chainage to MLWS the beach level is around 0.5m lower than in October 2013.</p> <p>Profile 1cHN2 shows stability from 0m to 50m chainage. Between 50m and 100m chainage the dune front has retreated by 1.3m and the upper beach has lowered by 1.1m since October 2013. The profile is similar between 100 and 118m chainage, below which the trough has developed, lowering the beach by around 0.2m as far as 127m chainage. From 127m to 166m chainage the beach has accreted and between 166m and 190m chainage the profile is similar to October 2013. However, between 190m and MLWS the beach has accreted significantly by around 1.2m, creating a gentler profile slope. Except at the dune front, that has eroded more than seen in the past, the profile is within the range of previous surveys. .</p> <p>Profile 1cHN2a was established in October 2011 and runs through the dunes close to North Sands. The part of the survey over the dunes to 70m chainage has remained stable since October 2011. Between 70 and 90m chainage the dune front has eroded by around 8m and the upper beach is 1m lower than in October 2014. The beach has accreted between 110m and 180m chainage by around 0.5m and experienced slight erosion (ca. 0.3m) between 180m and 205m chainage. The foreshore at</p>	<p>In the north-westerly, undefended parts of the bay the March 2014 survey shows a pattern of significant dune erosion and upper beach lowering. This is accompanied by deposition nearer low water to create a shallower slope than in the October 2013 profiles. The defended sections of coastline in the southeast of the bay are generally also at their lowest. The exception is profile 1cHN4 where a substantial amount of sand has accreted against the sea wall.</p> <p>This effect is probably a result of the significant storm surge that occurred in December 2013.</p> <p>Longer term trends:</p> <p>The pattern of dune erosion and back shore lowering is unprecedented in the monitoring record. Future data will show how long recovery takes. Exposure of the shore platform in the defended section to the south of the bay continues.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>low water, between 205m and the end of the survey at 300m chainage, has accreted significantly (>1m) creating a substantially gentler slope in the lower intertidal zone. The upper beach and dune front are at their lowest and most significantly eroded since 2011 but the rest of the beach and foreshore are within the range of profiles recorded since 2011. .</p> <p>At Profile 1cHN3 the peak in the profile at 35m chainage, which has been progressively accreting between 2008 and 2013, has remained stable between October 2013 and March 2014. From 40m to 110m chainage the dune front, upper beach and upper intertidal zone have been eroded with the maximum lowering of 1.25m occurring at 42-52m chainage. From 110m chainage to the end of the survey at 250m chainage near low water, the beach has accreted, with the berm in the lower intertidal zone returning to a similar elevation to that seen in April 2013. However, with the exception of October 2013, the lower intertidal zone is at its lowest level since monitoring began in 2008.</p> <p>At Profile HN3a the dune front at 18m chainage has retreated by around 2m from its position in the October 2013 survey and the beach and foreshore between 25m and 80m has been lowered by around 0.5m. Accretion of up to 0.6m has occurred between 80m and 128m chainage, and around 0.4m between 144m and the end of the survey at 182m chainage. Overall, when compared to earlier surveys the level of the beach is low, but within the past range.</p> <p>Profile 1cHN4 has generally remained unchanged since October 2013. Changes have occurred at the base of the sea wall to 64m chainage where the beach has accreted by around 0.6m. A 0.9m thick berm that was previously present between 64 and 115m chainage has been eroded to expose the underlying rocky shore platform. From 115m chainage to the end of the survey at 130m chainage, sand is present and the profile is slightly lower than the previous survey. The March 2014 survey shows the lowest profile since monitoring began in 2008, with the most extensive exposure of rocky shore platform.</p> <p>Profile 1cHN4a was established in October 2011. The defended part of the profile to 10m chainage has not changed since October 2011. The shore platform is exposed for much of the survey, which is due to a 0.8m drop in beach level which occurred between September 2012 and April 2013.</p>	

2.2 Middleton

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>19th March 2013</p>	<p>Beach Profiles:</p> <p>Middleton is covered by one beach profile line during the Partial Measures survey (Appendix A). The profile was last surveyed in September 2013.</p> <p>Profile 1cHC1 has eroded by around 0.8m at the toe of the sea wall since September 2013 and the extent of the erosion continues as far as 66m chainage. From 66m chainage 160m chainage the beach has accreted slightly (up to 0.4m). Between chainage 160m and the end of the survey at ca. 230m chainage, the beach profile is very similar to that recorded in September 2013.</p>	<p>The beach was at a low level compared to the previous surveys, as can be expected following winter storms and the storm surge.</p> <p>Longer term trends: The beach level at this location tends to fluctuate through the year, with the most variable area being adjacent to the sea wall where wave energy is reflected. There a pattern of seasonal variation, with lower levels typically recorded in the spring, following the period of winter storms. Recovery tends to occur by the autumn.</p>

2.3 Hartlepool Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>19th March 2014</p>	<p>Beach Profiles:</p> <p>Hartlepool Bay is covered by four beach profile lines during the Partial Measures survey (Appendix A). The profiles were last surveyed in September 2013.</p> <p>Profile 1cHS1 is located c. 150m south of the root of the South Pier. The profile starts at the wall to the rear of the promenade and extends over the fronting concrete splash wall and down the sloping face of the rock armour revetment before reaching the beach. Very little change has occurred until 70m chainage since September 2013. From 70m chainage to the end of the survey at 125m the lower intertidal zone has accreted by around 0.6m.</p> <p>Profile 1cHS2 shows limited differences between the September 2013 and March 2014 surveys. The most significant is accretion of 0.4m of sand at the upper beach between the base of the rock armour at 30m chainage and 150m chainage. Limited lowering of the profile has occurred between 200m and 310m chainage. Deposition appears to have occurred between chainage 310m and 340m chainage. The overall effect of these changes is to create a consistently sloping profile with fewer variations in slope angle than in the immediately preceding surveys.</p> <p>At profile 1cHS3 there were no changes between the start of the survey and 30m chainage between March 2014 and September 2013. Between 30m and 110m chainage, the level of the beach has reduced by around 0.4m but accreted between 110m and 175m chainage by a similar amount. The lower intertidal zone has accreted by around 0.4m between 200m and 240m chainage except at the very end of the profile between 240 and 250m chainage where the profile has steepened.</p> <p>Profile 1cHS4 is located 1km north of the North Gare Breakwater, within the area of undefended dunes at Seaton Carew. The dune front has retreated by around 1m and the area between two dune ridges at c. 270m chainage and c. 320m chainage has lowered by around 0.5m. A limited amount of accretion has occurred between MHWS and 420m and there has been more substantial erosion of sand (up to 0.7m lowering of the beach profile) between 420m and 456m chainage to create the steepest profile in the mid-upper intertidal zone since monitoring began in 2009. Between 456m chainage and MLWS a substantial berm at least 1m high has appeared, pushing MLWS beyond 580m chainage and reversing the pattern of erosion of the lower intertidal zone seen since 2012.</p>	<p>The March 2014 data show that deposition or bar formation in the lower intertidal zone has occurred in all profiles, with the bar formation being most pronounced in the southerly profiles. The more southerly profiles (1cHS3 and 1cHS4) show erosion of the upper beach and dune front. This is likely due to differences in exposure to the storm surge and other winter storms.</p> <p>Longer term trends: With the exception of 1cHS4, beach levels within Hartlepool Bay in March 2014 were amongst the highest recorded in comparison to previous surveys. 1cHS4 continues to show the steep, irregular beach profile it has had since April 2013, but may flatten if surging summer waves push some of the accumulated sediment in the substantial sand bar further up the beach.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

No problems are reported in the survey report.

4. Recommendations for 'Fine-tuning' the Monitoring Programme

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At North Sands the furthest northwest profiles (in the undefended part of the bay) show dune face erosion and upper beach lowering, which probably occurred during the storm surge of December 2013. The dune toe is at its furthest landward extent since monitoring began and future reports should review how the beach reacts to this change. Substantial amounts of the rocky shore platform in the lower part of the intertidal zone continue to be exposed in the more southern, defended sections of the bay.
- At Middleton the beach has eroded in its upper part adjacent to the sea wall and accreted further downslope. This level of seasonal variability is normal and there is no cause for concern
- Hartlepool Bay has been subject to further steepening of the beach at its southern extent, with some erosion of the dune toe and lowering of the base of a hollow inland of the foredune. However, a substantial bar has accreted which may weld to the shore over the summer to create a more gently sloping beach. All profiles show a degree of deposition in the lower intertidal zone and with the exception of the most southerly profile (1cHS4) are relatively high in comparison to previous surveys.

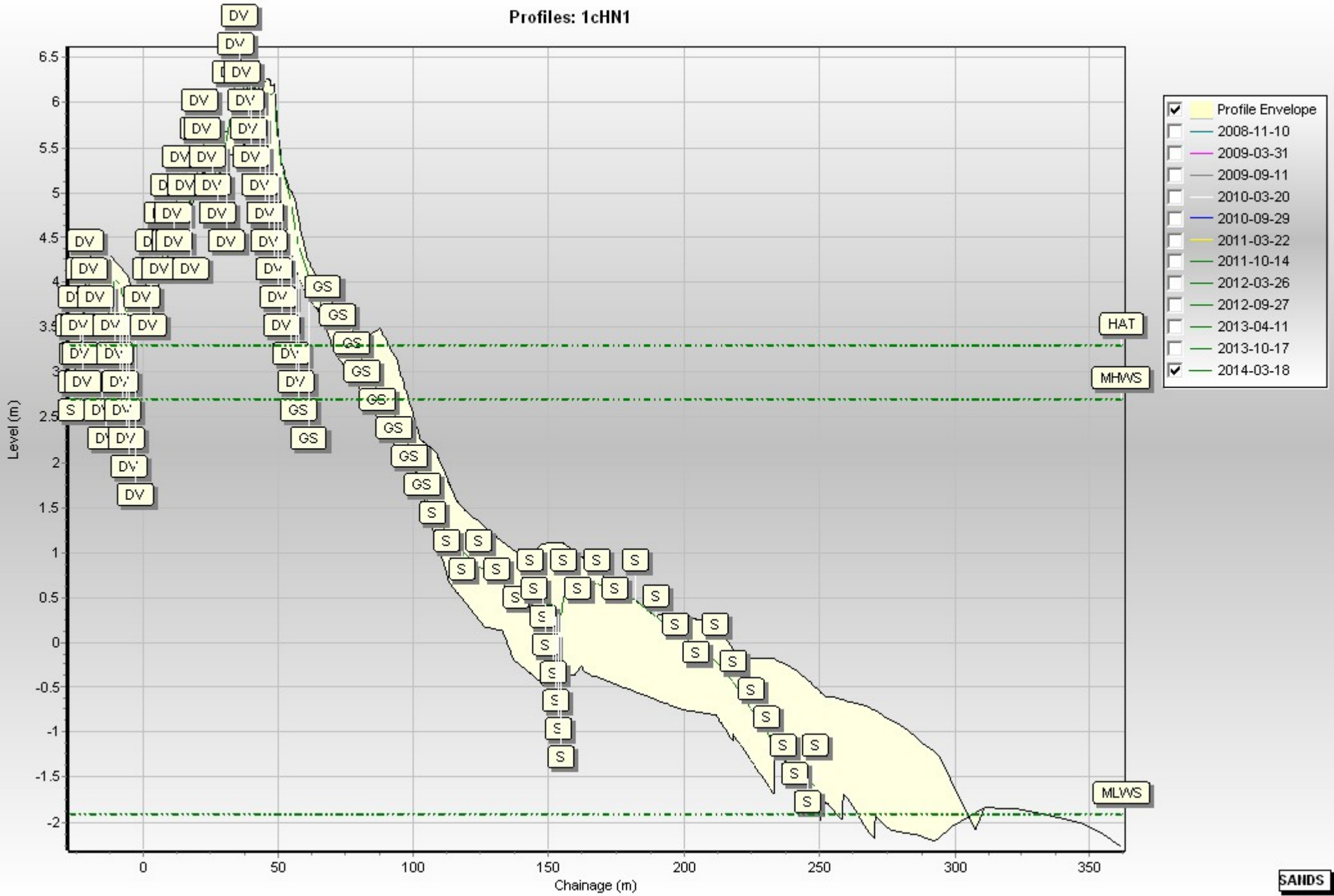
Appendices

Appendix A
Beach Profiles

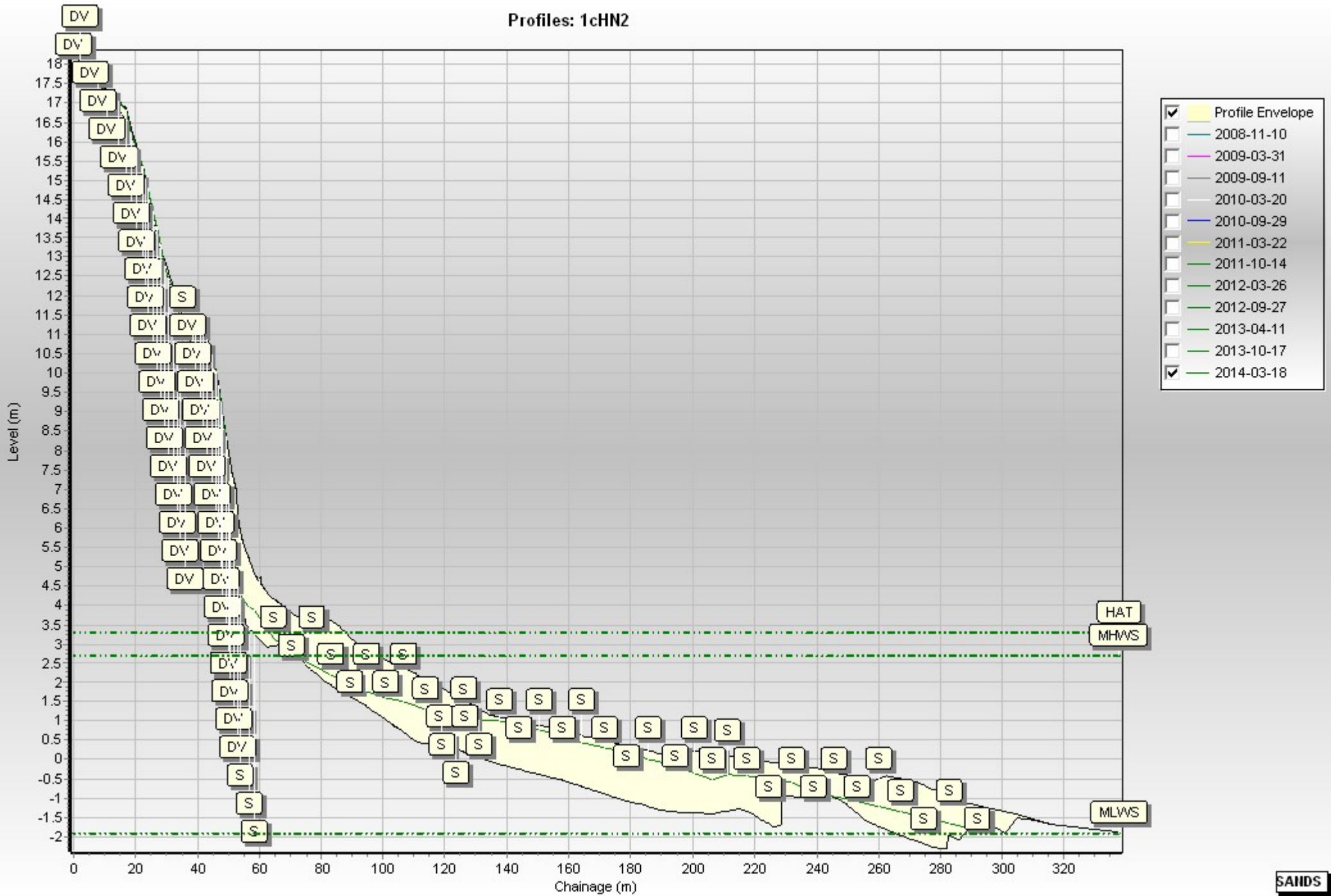
The following sediment feature codes are used on some profile plots:

Code	Description
S	Sand
M	Mud
G	Gravel
GS	Gravel & Sand
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Saltmarsh
W	Water Body
GM	Gravel & Mud
GR	Grass
D	Dune (non-vegetated)
DV	Dune (vegetated)
F	Forested
X	Mixture
FB	Obstruction
CT	Cliff Top
CE	Cliff Edge
CF	Cliff Face
SH	Shell
ZZ	Unknown

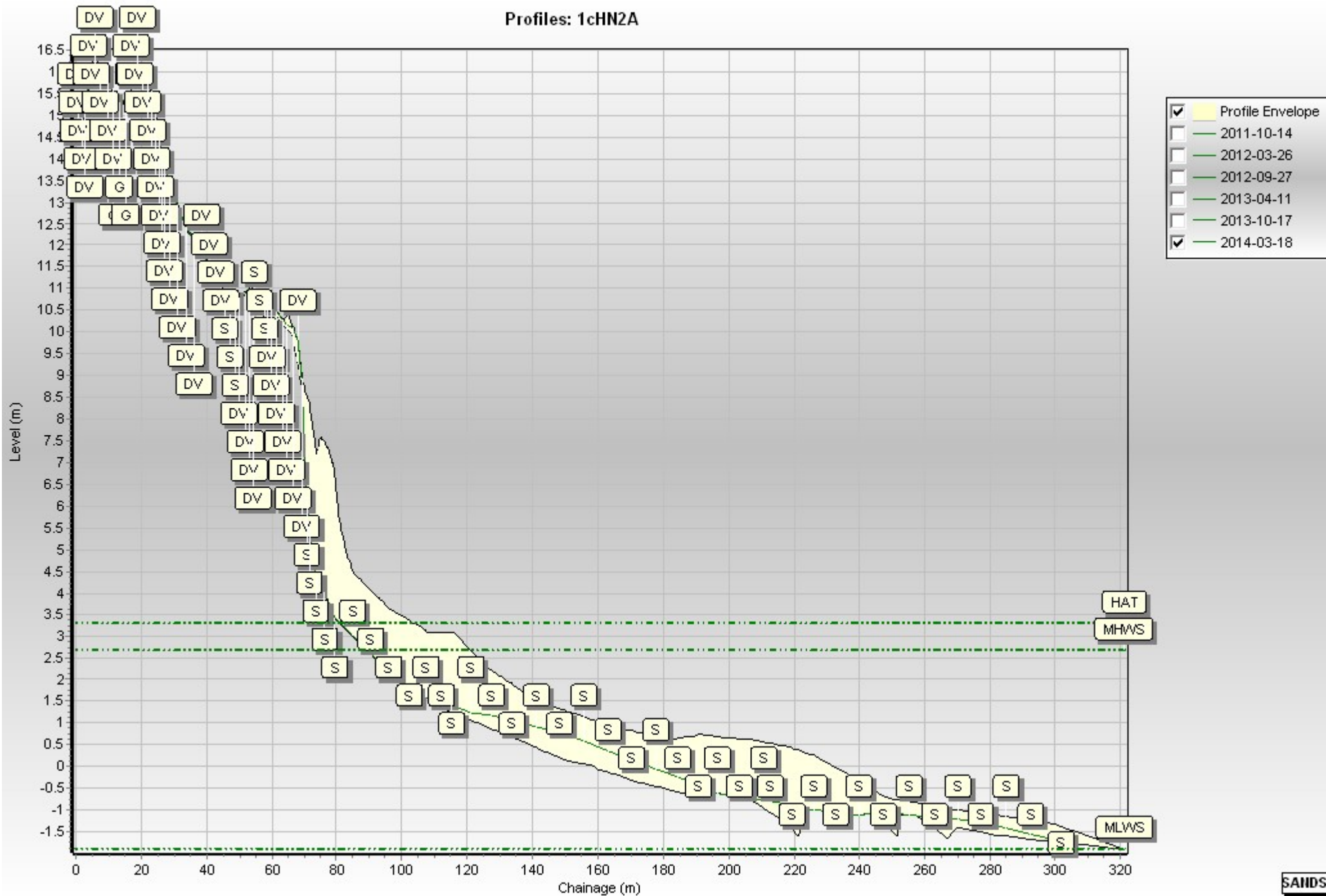
Profiles: 1cHN1



Profiles: 1cHN2



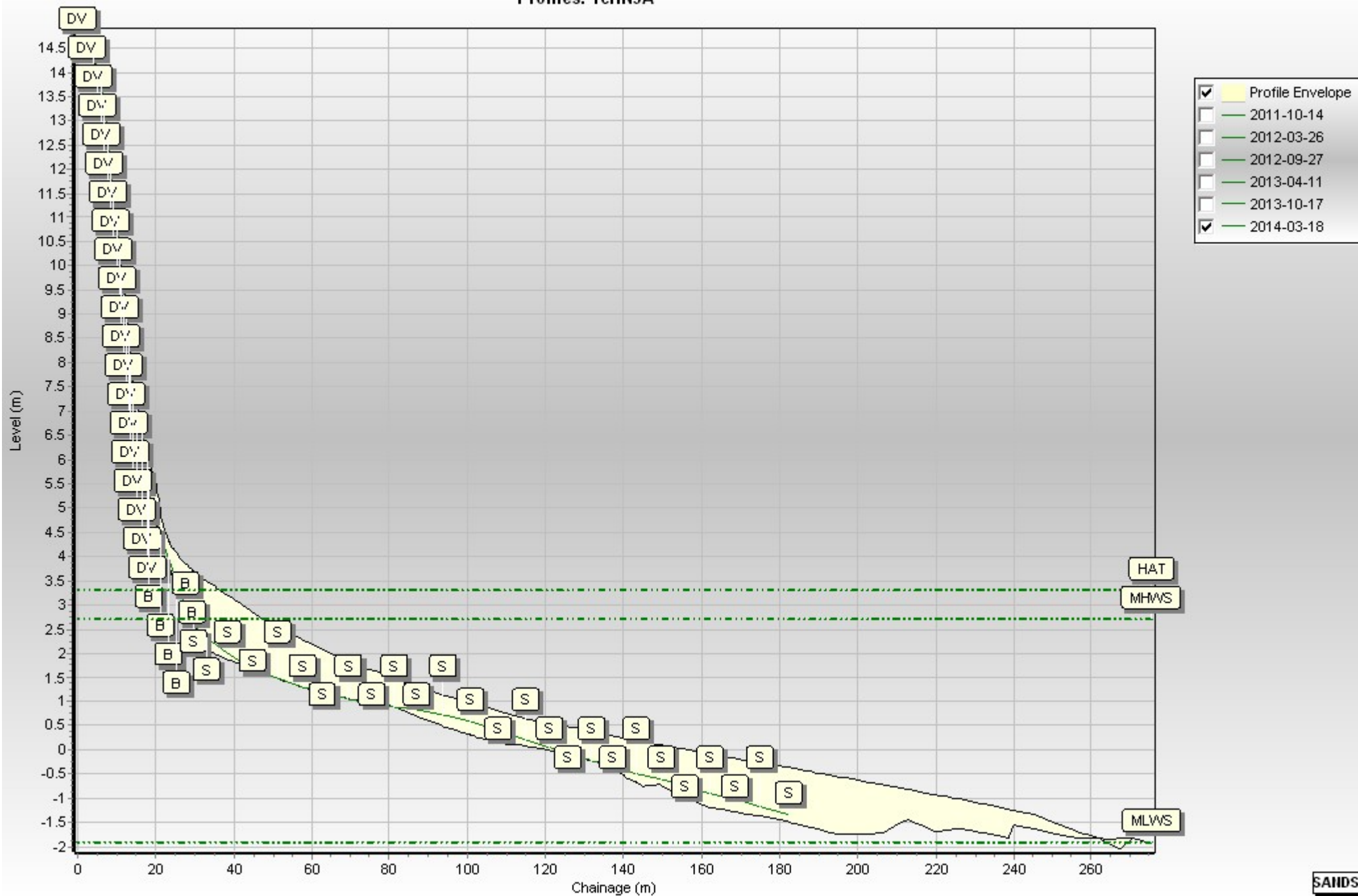
Profiles: 1cHN2A



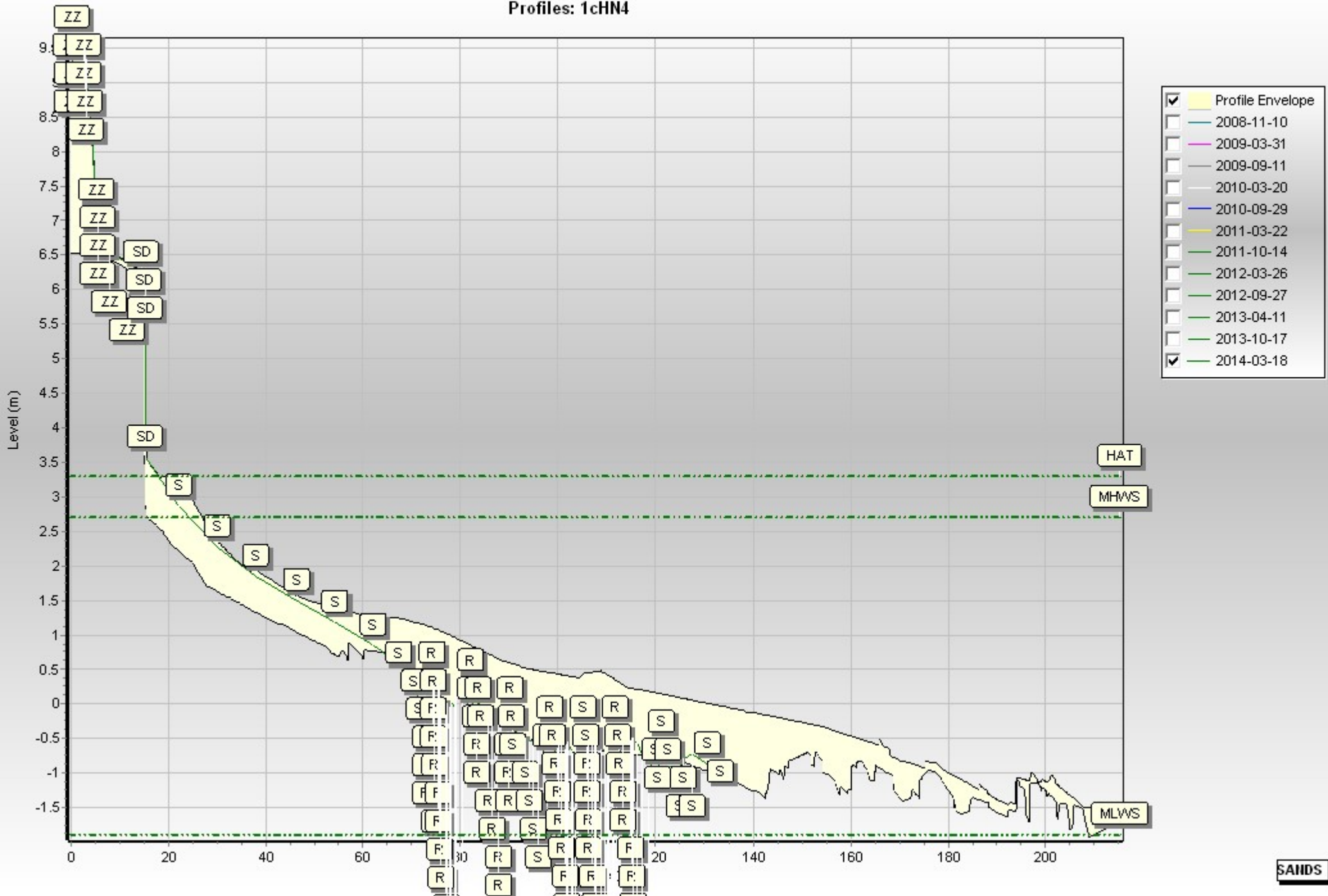
Profiles: 1cHN3



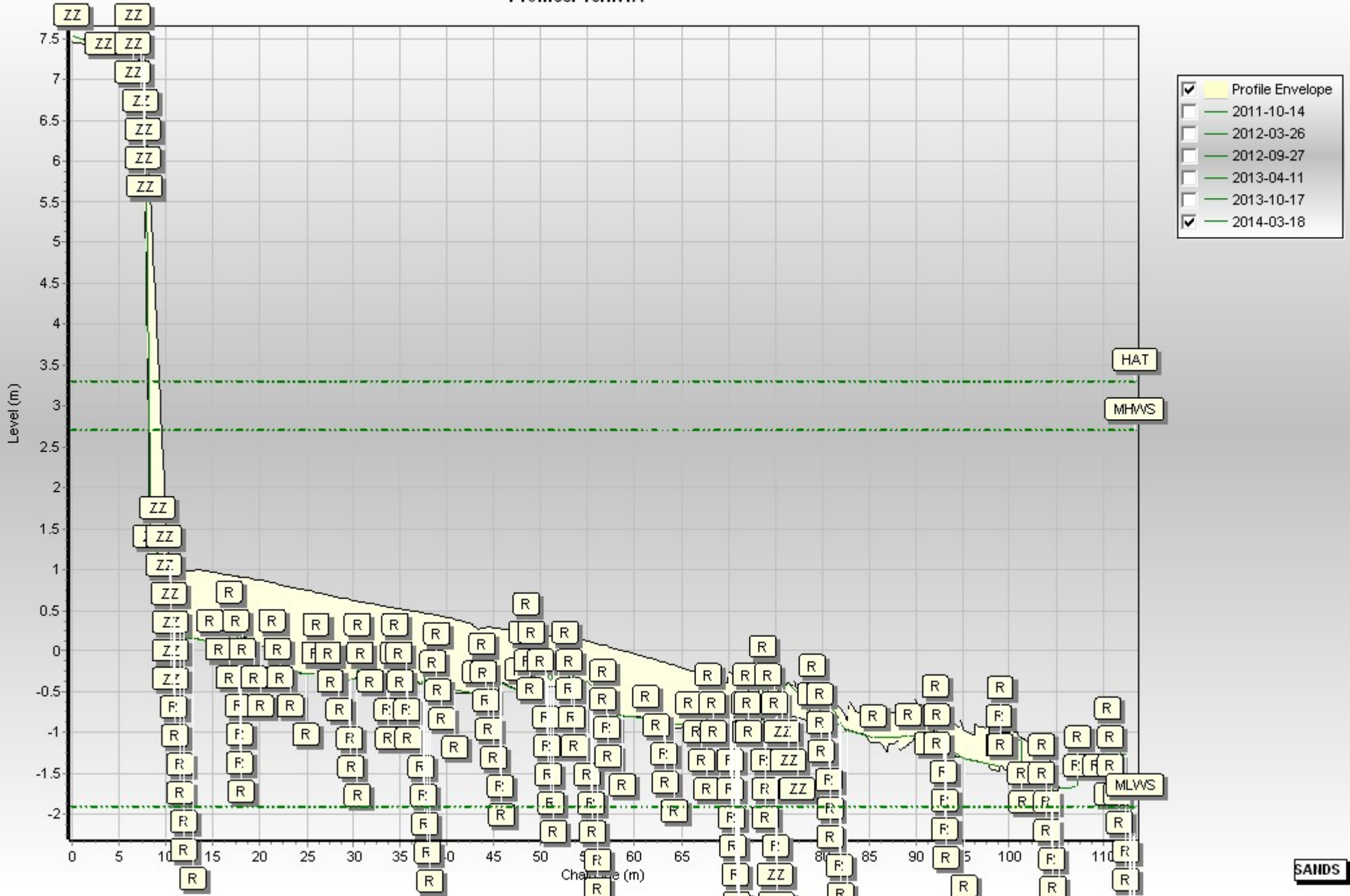
Profiles: 1cHN3A



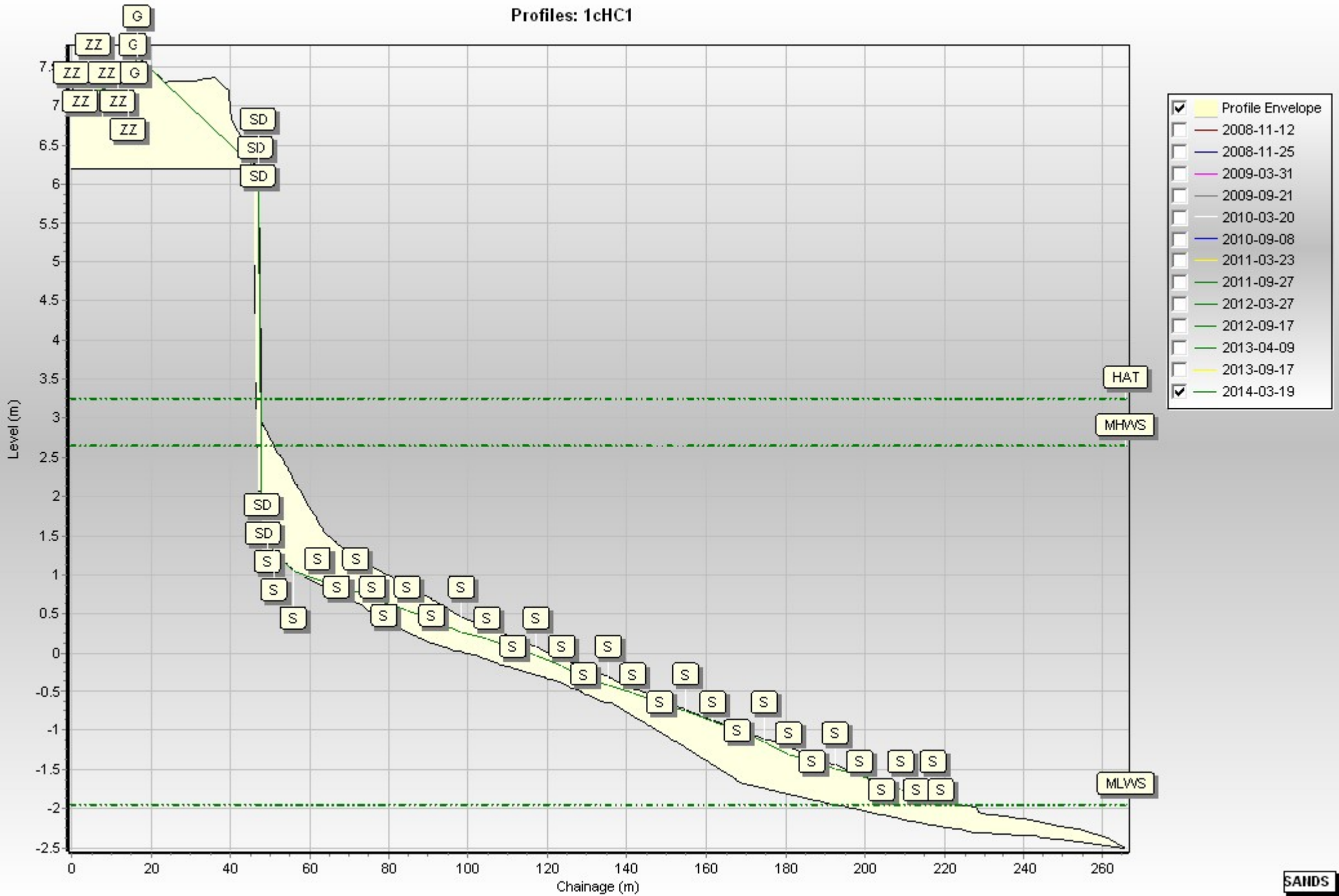
Profiles: 1cHN4



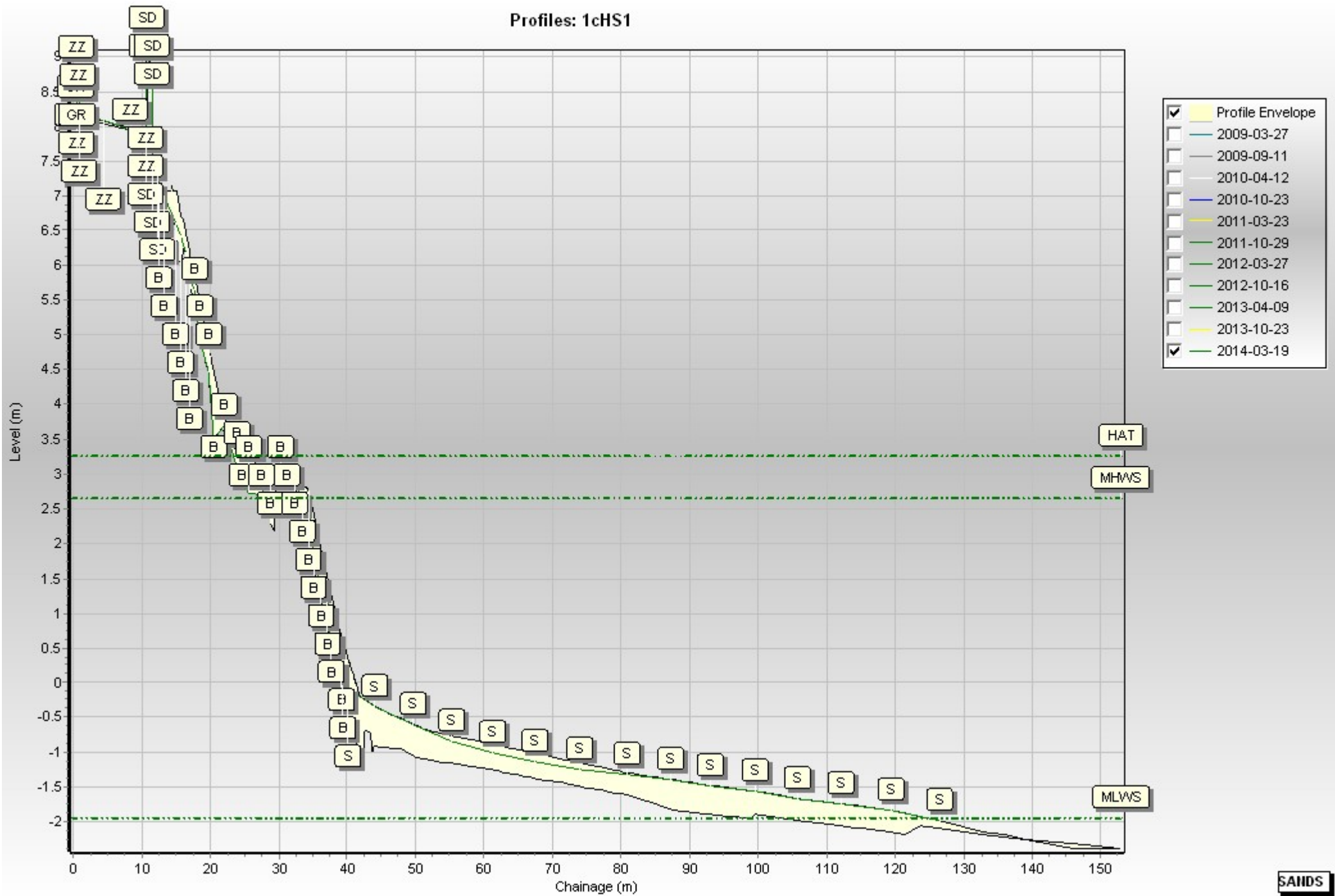
Profiles: 1cHN4A



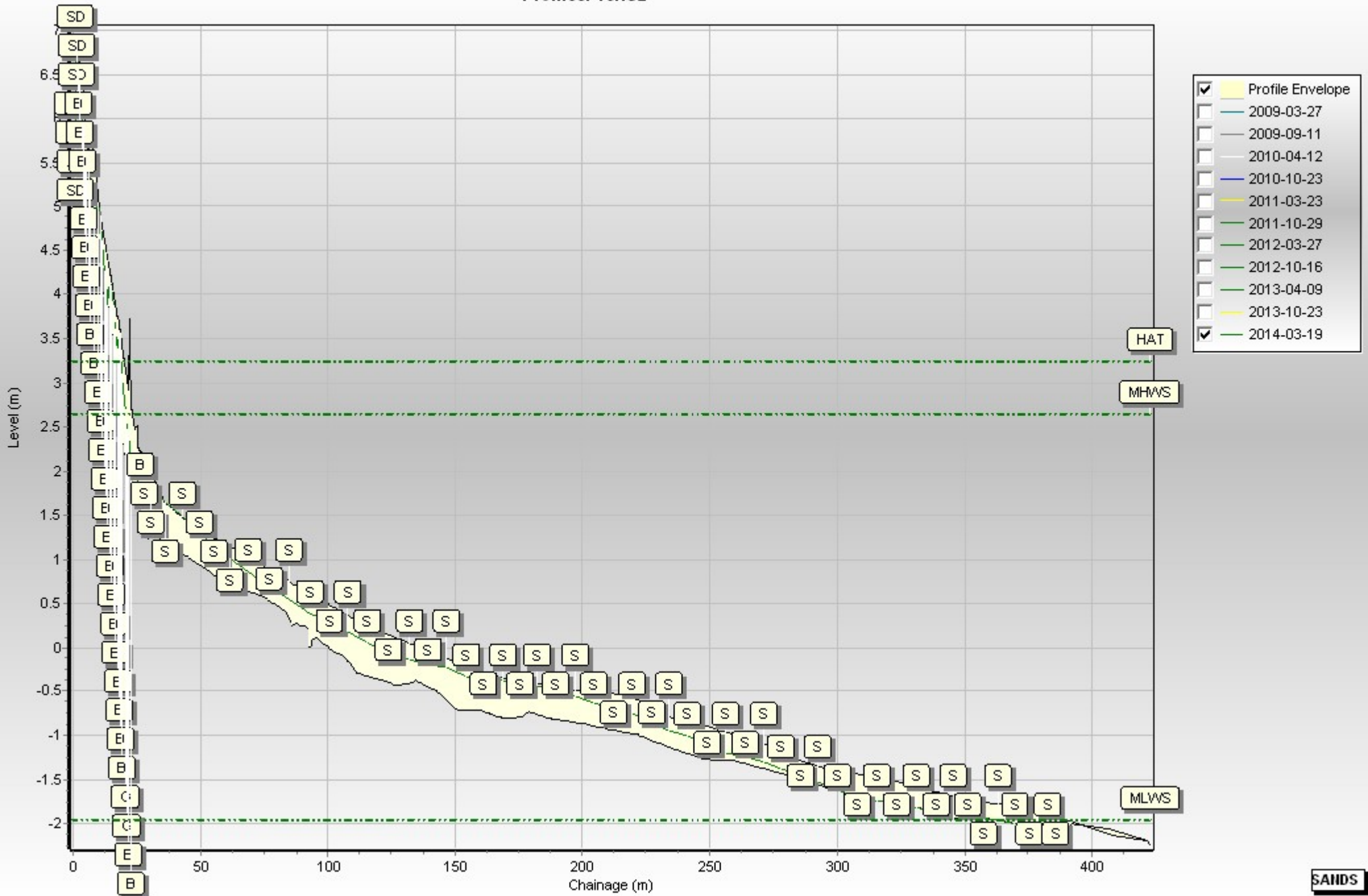
Profiles: 1cHC1



Profiles: 1cHS1



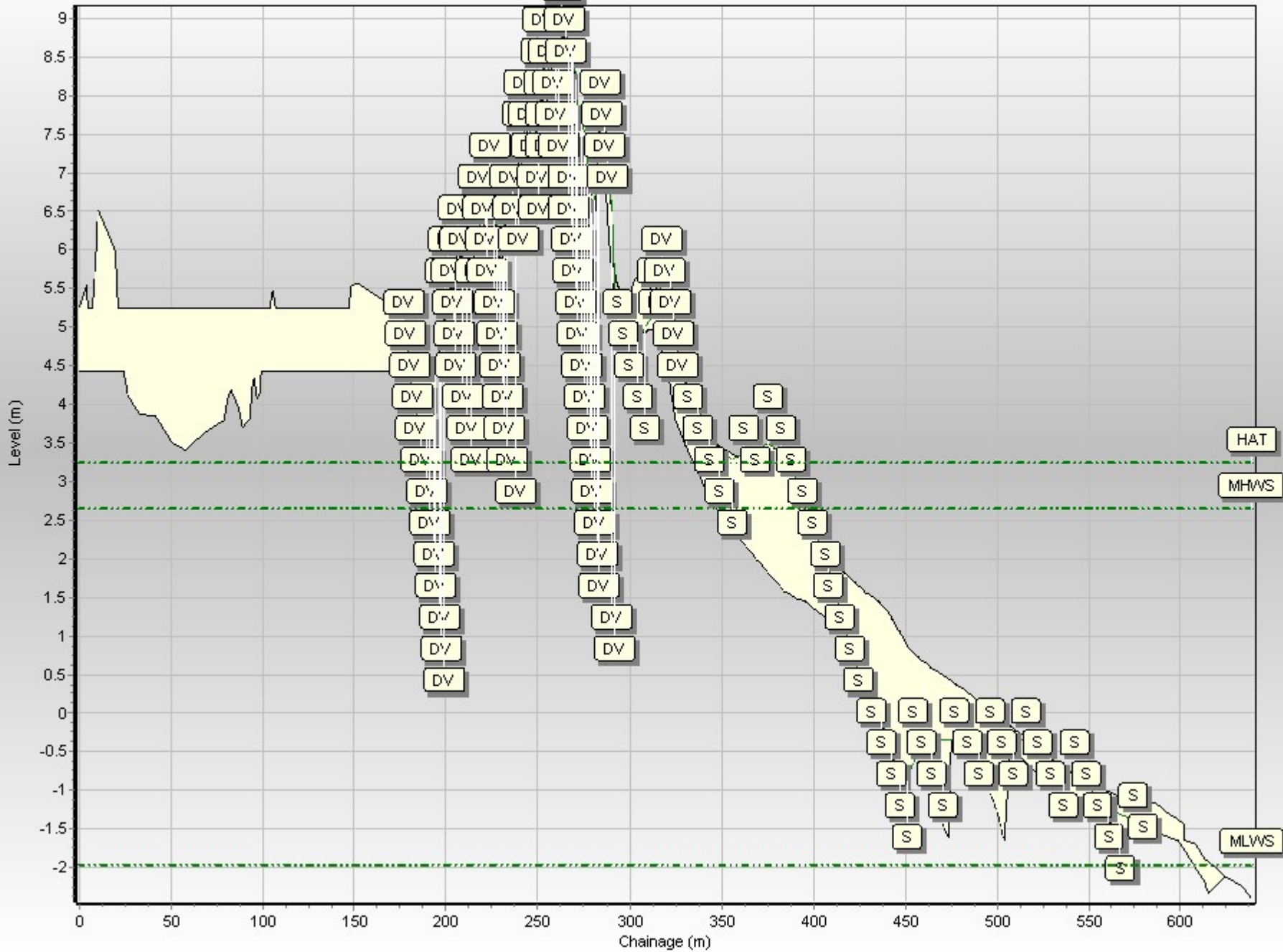
Profiles: 1cHS2



Profiles: 1cHS3



Profiles: 1cHS4



- Profile Envelope
- 2009-03-27
- 2009-09-11
- 2010-04-12
- 2010-10-23
- 2011-03-23
- 2011-10-29
- 2012-03-27
- 2012-10-16
- 2013-04-09
- 2013-10-23
- 2014-03-19